A.29 Alkali Milk-Vetch (*Astragalus tener* var. *tener*)

A.29.1 Legal Status

Alkali milk-vetch (*Astragalus tener* var. *tener*) is not listed under either federal or California Endangered Species Acts. Its Heritage Ranking in the California Natural Diversity Database is G1T1/S1.1 which means that globally (G) and within the state (S) both the species and variety have either less than 6 viable element occurrences, less than 1,000 individuals, or less than 2,000 acres of occupied habitat. Its state threat level rank is "very threatened."

The California Native Plant Society (CNPS) List ranking of 1B.2 for alkali milk-vetch indicates that it is rare, threatened, or endangered in California and elsewhere, and is considered by CNPS to be fairly endangered in California with between 20 to 80 percent of occurrences threatened. Plants with a List rank of 1B are considered by the California Native Plant Society to meet the definitions of Section 1901, Chapter 10 (Native Plant Protection Act) or Sections 2062 and 2067 (California Endangered Species Act) of the California Fish and Game Code.

A.29.2 Species Distribution and Status

Range and Status

The range of alkali milk-vetch extends from Sonoma, Napa, Solano, and Yolo Counties in the north, to Monterey and San Benito Counties in the south, to San Francisco, Contra Costa, Alameda, and Santa Clara Counties in the west, and San Joaquin, Stanislaus, and Merced Counties in the east (Figure A.29.1). Alkali milk-vetch was widely distributed around the San Francisco Bay region and in the Sacramento and northern San Joaquin Valleys 100 years ago (Barneby 1964), but by 1989, only a few populations remained (Liston 1992). A 2002 survey concluded that 25 of the 65 known occurrences should be considered extirpated (Witham 2002). Sixteen of the known extant occurrences are in the Solano-Colusa Vernal Pool Region of Solano County (Keeler-Wolf et al. 1998), and another five are located in an area between Newman, Merced, and Los Banos in the San Joaquin Vernal Pool Region of Merced County (Silveira 1996 as cited in USFWS 2005, CNDDB 2008). In Yolo County, Crampton (1979) noted the presence of this species near the City of Woodland on the Maupin property. A 1990 survey of historical collection sites in Yolo and Solano Counties found six plants at the City of Woodland Preserve and six small populations at the Jepson Prairie Preserve (Witham 1990). Currently, the Yolo County distribution of adult plants of this species includes the City of Woodland Preserve, the Woodland Regional Park, the Brauner and Maupin (near the Road 25 and 103 intersection) properties, the McClellan AFB Davis Communications Facility site, the Tule Ranch California Department of Fish and Game Reserve, which is in the Yolo Bypass portion of the Bay/Delta project area, and the Willow Slough Bypass (Showers 1996, EIP Associates 1998, Foothill Associates 2002, Witham 2003, University of California Davis Herbarium 2004, Environmental Science Associates and Yolo County Planning & Public Works Department 2005, A. Shapiro pers. comm. 2005).

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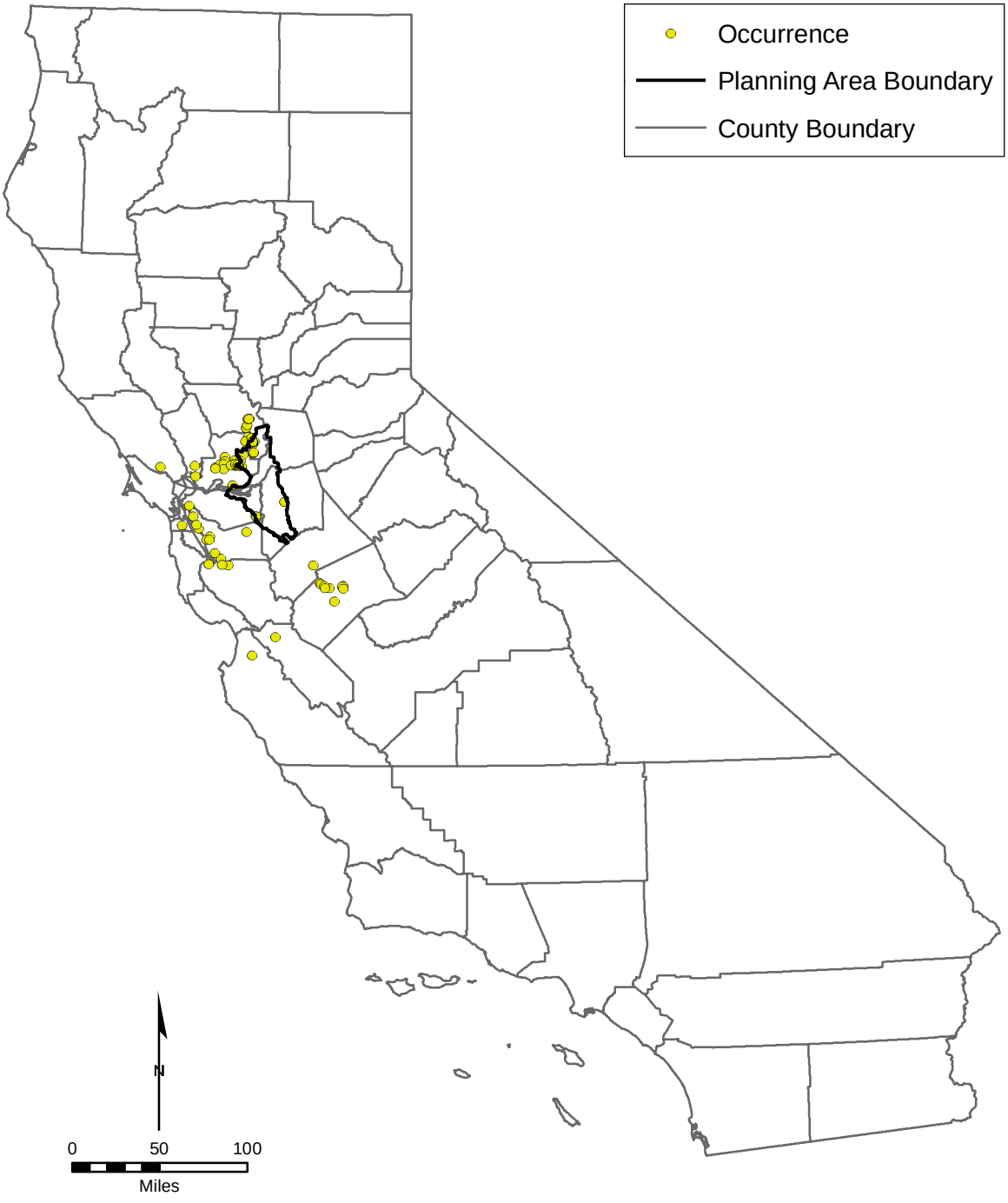

Source: California Department of Fish and Game, CNDDB, 2008.
Consortium of California Herbaria, 2008.

Figure A.29.1. Alkali Milk-Vetch Statewide Recorded Occurrences

Distribution and Status in the Planning Area

Within the BDCP Planning Area are several reported occurrences (Figure A.29.2). Small groups of up to 20 plants are found on suitable habitat throughout Tule Ranch (Witham 2003). South of that location, in the Yolo Bypass, it has been observed 1/4 mile south of Saxon Station. To the west, it was reported as observed growing in clay soils west of Bunker Station. To the south, multiple sightings have been observed in vernally wet grassland in the Jepson Prairie Preserve. Further south, it was observed in an alkaline vernal pool in the Montezuma Wetlands Restoration Project. On the southwest edge of the BDCP Planning Area it has been observed in alkaline grassland vegetation northwest of the junction of Byron Hot Springs Road and Armstrong Road (CNDDB 2008). A previous instance observed in the Stockton area near Smith Canal is believed to be extirpated (CNDDB 2008).

A.29.3 Habitat Requirements and Special Considerations

Little is known about the ecology of alkali milk-vetch. In the Central Valley, it appears to be restricted to alkaline soils in areas that are, or were historically subject to flooding and overland flows (Silveira 2000, Witham 2003, Environmental Science Associates and Yolo County Planning & Public Works Department 2005). At the McClellan AFB Davis Communications Facility site in Yolo County, it is found growing on the annual ryegrass (*Lolium multiflorum*) dominated floodplains above the upper margins of vernal pools and swales that contain Solano grass (*Tuctoria mucronata*) and Colusa grass (*Neostapfia colusiana*) (Environmental Science Associates and Yolo County Planning & Public Works Department 2005). All individuals at that site were found in areas that had been subjected to a prescribed burn and which subsequently flooded briefly in February (Environmental Science Associates and Yolo County Planning & Public Works Department 2005). In two subsequent years, the same area burned due to arson caused fires and also flooded during the winter, but only a few individuals were detected during the following springs in contrast to the large population that established after the prescribed burn (J. Gerlach unpubl. data). At the Tule Ranch site in the Yolo Bypass, it is found in vernally mesic grasslands dominated by annual ryegrass and associated with alkaline vernal pools (Witham 2003). It is also found near the City of Woodland and along the Willow Slough Bypass in Yolo County in areas that were once alkali sink vegetation, but which were converted to rice fields and then fallowed for many years or which were converted into a levee system (Andrews 1970, Crampton 1979, Showers 1988, 1996, EIP Associates 1998, Foothill Associates 2002). There were historical occurrences along the railroad tracks north of the City of Davis and on the Hunt and Wesson tomato canning plant property (CNDDB 2008), but no individuals were located during surveys of those areas in 2006 (J. Gerlach unpubl. data). The canning plant has been closed for several years and the alkaline soil areas are no longer farmed and are now densely vegetated with annual ryegrass (J. Gerlach unpubl. data). In the greater Jepson Prairie area it grows in vernal pool grassland that is dominated ay annual ryegrass (Witham 2006).

The populations southeast of the City of Woodland and north of the City of Davis are in a heavily human-impacted area of what historically was alkaline sink vegetation lying along both sides of the north channel of Putah Creek and Willow Slough and above the Yolo Basin (U. S. Bureau of Soils 1909a,b, Mann et al. 1911). The hydrology, salts, and clay soils that created and maintained the alkaline sink vegetation were deposited when floodwaters from Putah Creek

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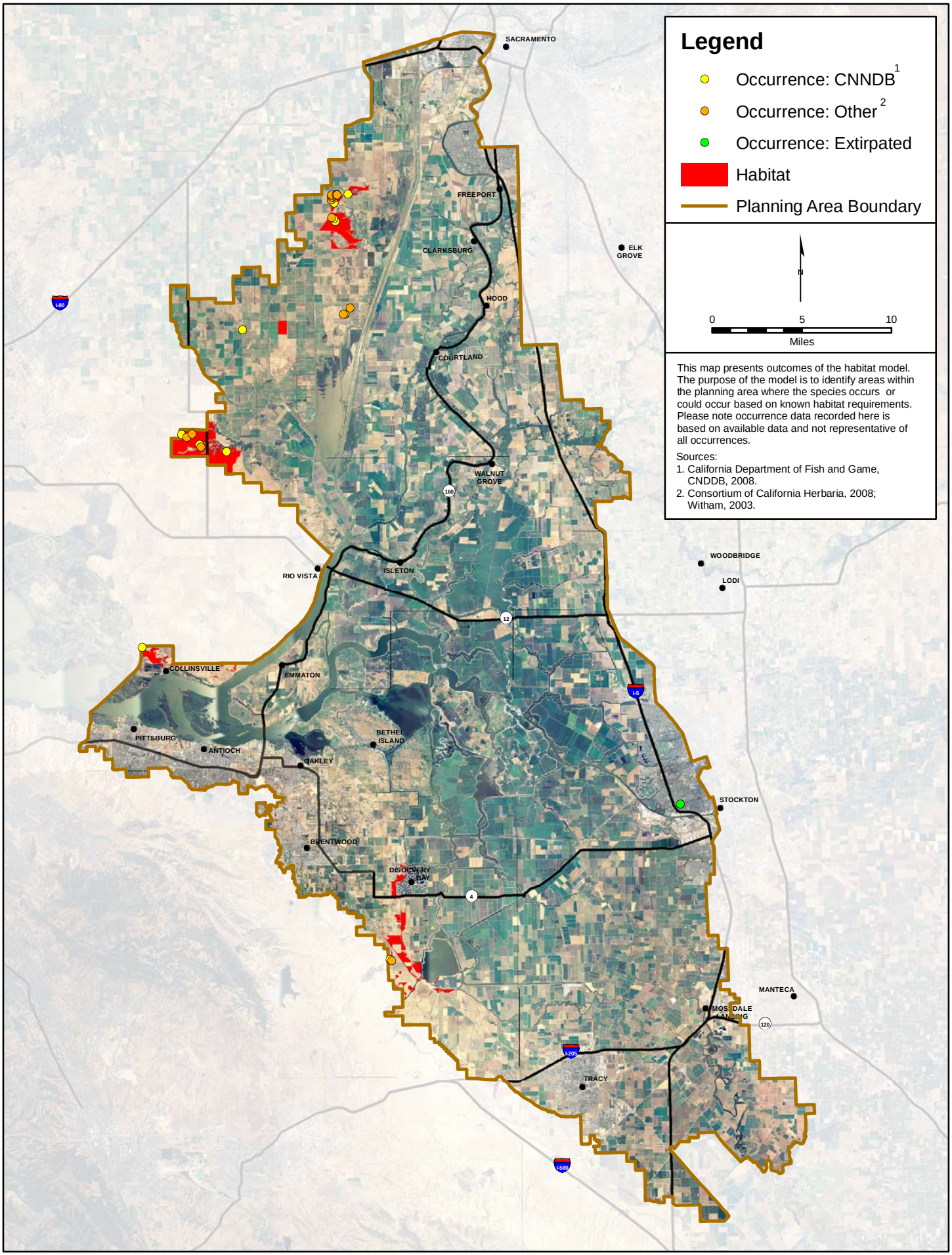

Figure A.29.2. Alkali Milk-Vetch Habitat Model and Recorded Occurrences

flowed northward from the area near the City of Davis and empted into Willow Slough. That flow was also supplemented when the combined floodwaters of Putah Creek, Cache Creek, and all of the drainages of the Blue Ridge filled the Cache/Putah Basin, drained eastward through a gap in the Plainfield Ridge, and flowed into the Yolo Basin through Willow Slough (Graymer et al. 2002). This area has also been heavily invaded by annual ryegrass (Dawson et al. 2007).

Laguna Callé, as Willow Slough was previously known, was a unique perennial stream (Eliason 1850, Anonymous 1870) that during the dry season originated from a series of pond-like springs approximately 9 miles southwest of Woodland on the eastern edge of the Plainfield Ridge. As the slough approached the area of Merritt, south of the City of Woodland, it transformed into a 2.5-mile long, gravel bottomed, linear lake, with an average width of 150 feet (ft) and a maximum depth of 75 ft. Approximately 1 mile east of County Road 103, the stream flowing from the lake branched as it dropped over the edge of the alluvial deposits into the Yolo Basin, where it flowed another 2.5 miles northeastward until it emptied into a tule marsh. Large floods from Cache Creek and Putah Creek have flowed through Willow Slough as recently as 1942, but gravel mining in Cache Creek, dam building on both Cache and Putah creeks, and the construction of the Willow Slough Bypass have drastically altered the hydrology, salt budgets, and clay deposition patterns in the area of the alkali sink vegetation. Aerial photographs show that all of the alkaline sink vegetation was converted into various kinds of agricultural fields, ditched for drainage (USDA 1952), or subsequently developed as the cities expanded. Given the intensity and extent of the agricultural impacts to the entire alkali sink area and the irreversible changes in hydrology, those areas do not currently support alkali sink vegetation and it would be very difficult to replicate the natural hydrological regimes that would allow that type of vegetation to be successfully restored in the area.

There are few data documenting the population trends of alkali milk-vetch. Because most of the recent observations of individuals have been at sites where it was considered extirpated, it appears that those individuals have established from pre-existing long-lived seed banks. Witham's observation that recruitment increased in a population near the Jepson Prairie Preserve after pipeline construction (CNDDB 2008) appears to confirm the importance of the seed bank. More recently, a large multi-year survey of California's vernal pool vegetation found that alkali milk-vetch was the most variable rare taxon and only occurred once during the 5-year study at a very low cover value (1 percent) (Buck 2004, Barbour et al. 2007).

A.29.4 Life History

Alkali milk-vetch is a 4 to 40 centimeter (cm) (2 to 16 inches) tall herbaceous annual plant in the pea family (Fabaceae) (Hickman 1993) that has been differentiated from Ferris' milk-vetch (*Astragalus tener* var. *ferrisiae*) based on the morphology of its fruits (Liston 1990, 1992). Alkali milk-vetch has short, stout, strongly curved pods (Witham 2003). The leaves of alkali milk-vetch are 2 to 9 cm (1 to 3 inches) long, with 7 to 17 pinnately compound, well-separated leaflets. Three to 12 pink-purple, pea-like flowers comprise a dense inflorescence.

A protein electrophoresis analysis of two populations, one from Jepson Prairie in Solano County and the other from northern Merced County, found very little genetic differentiation between the populations and high levels of genetic diversity within each population (Liston 1992). This technique uses allozymes or slight alterations in plant proteins as indicators or markers. Because small mutations in the genetic code results in markers that are generally invisible to the forces of natural selection, these allozyme markers are classified as neutral markers. Therefore, because the neutral markers used in the study have not been shown to be correlated with any traits that

might provide an adaptive advantage, Liston's results provide no information concerning the extent of local adaptation or other measures of the "genetic health" of the populations and no information regarding the amount of variation for adaptive traits (McKay et al. 2001, McKay and Latta 2002, Latta and McKay 2002, Wayne and Morin 2004).

Based on a crossing study by Liston (1992), the species was found to be self-compatible, and the inbreeding coefficients for the two populations were not significantly different from the expected value for a randomly mating population. Therefore, Liston concluded that insect pollinators are responsible for maintaining high levels of outcrossing within the populations. Liston also concluded that the recent dramatic range and population reductions experienced by alkali milk-vetch might explain the lack of neutral marker differentiation between the two populations and that the lack of interpopulational neutral marker differentiation might also be attributed to a seed bank, as milk-vetch species are known to produce long-lived seed banks. Liston indicated that the unique morphology of the plant's flower suggested that alkali milk-vetch is pollinated by butterflies, which is rare for a species in the pea family (Liston 1992).

If Liston's conclusion is correct, the most likely pollinators could be small skippers, such as the pygmy blue (*Brephidium exile*) and the eastern tailed blue (*Everes comyntas*) (A. Shapiro pers. comm.). The host plants for these insects in the Willow Slough area of Yolo County are Torrey seepweed (*Suaeda moaquiannina*) and Australian saltbush (*Atriplex semibaccata*) for the pygmy blue; and purple vetch (*Vicia benghalensis*), hairy vetch (*Vicia villosa*), California tule pea (*Lathyrus jepsoni* ssp. *californicus*), Spanish lotus (*Lotus purshianus*), and bird's-foot-trefoil (*Lotus corniculatus*) for the eastern tailed blue (A. Shapiro pers. comm. 2005).

It is not known when or under which environmental conditions germination of alkali milk-vetch seeds occurs (USFWS 2005). Skinner and Pavlik (1994) indicate the flowering period to be March through June. Witham observed that recruitment increased in a population near the Jepson Prairie Preserve after pipeline construction (Witham 1990). Alkali milk-vetch was also observed in an artificially constructed vernal pool near Albrae at a site where no observations had been recorded since 1923 (USFWS 2005). These observations indicate the importance of a long-lived soil seed bank and suggest that viable seed may exist in the soil seed bank in areas where mature plants have not been observed for many years. This importance of a long-lived seed bank is also supported by studies that have found that this species persists across multiple seasons despite the absence of reproductive plants (Buck 2004, Barbour et al. 2007).

A.29.5 Threats and Stressors

Development, intensive agriculture, and exotic plant species (especially annual ryegrass) are considered the primary threats to alkali milk-vetch (Showers 1996, Witham 2003, Environmental Science Associates and Yolo County Planning & Public Works Department 2005, Dawson et al. 2007).

A.29.6 Relevant Conservation Efforts

Alkali milk-vetch is included in the Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon (USFWS 2005). Alkali milk-vetch is a covered species under the permitted San Joaquin County Habitat Conservation Plan (HCP) and is proposed for coverage under the Solano County HCP and Yolo County HCP/Natural Community Conservation Plan.

A.29.7 Species Habitat Suitability Model

Habitat. Alkali milk-vetch habitat was identified as Natural Seasonal Wetlands and Grasslands on Antioch (AoA), Capay (Ca, Cc), Clear Lake (Ck), Diablo (DaC), Hillgate (HcA), Marcuse (Mb, Mc, Sb), Marvin (Mf), Pescadero (Pc, Pk), Rincon (Rg), Scribner (245), and Solano (Sh, Sk) soils. Vegetation types designated as species habitat in this model correspond to the mapped vegetation associations in the BDCP GIS vegetation data layer. Aerial imagery (USDA 2005) and LiDAR elevation data (DWR 2007) were used to determine how intensively parcels included in the model had been farmed as the vegetation data included significant areas of fallow agricultural land that had been misclassified by DFG as various classes of natural vegetation. Parcels without natural vernal pool and swale vegetation signatures and microtopography were deleted from the area of predicted habitat. Additionally, parcels with known occurrences were digitized and included as habitat.

Assumptions. Historical and current records of this species in the BDCP Planning Area indicate that its current distribution is limited to alkaline soil areas with vernal pool and swale microtopography along the eastern border of the BDCP Planning Area (Figure A.29.2) (Witham 2002, 2003, 2006, Environmental Science Associates and Yolo County Planning & Public Works DepartmentESA 2005, Barona et al. 2007, CNDDB 2008). The vegetation cover of the alkaline soils is typically a combination of vernal pool adapted species and annual ryegrass (Witham 2002, 2003, 2006, CNDDB 2008).

A.29.8 Recovery Goals

Although alkali milk-vetch is not a federally listed taxon, it is included in the Draft Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon (USFWS 2005). The Recovery Plan explicitly states that its goal is to ensure the long-term conservation of this subspecies and 32 other taxa by using an ecosystem level strategy that is based on: current knowledge of the existing conditions of vernal pool communities; the distribution and status of the populations of each of the species, and current and anticipated process that impact vernal pool ecosystems. Because the goal of the Recovery Plan is primarily directed at habitat preservation, its implementation program specifically addresses factors that relate to habitat acquisition and management: 1) habitat protection; 2) adaptive habitat management and monitoring; 3) status surveys; 4) research, and; 5) public participation.

The CALFED Bay-Delta Ecosystem Restoration Program Plan's Multi-Species Conservation Strategy (MSCS) designates the alkali milk-vetch as "Contribute to Recovery" (CALFED Bay-Delta Program 2000). This means that CALFED will undertake actions under its control and within its scope that are necessary to recover the species. Recovery is equivalent to the requirements of delisting a species under federal and State ESAs.

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